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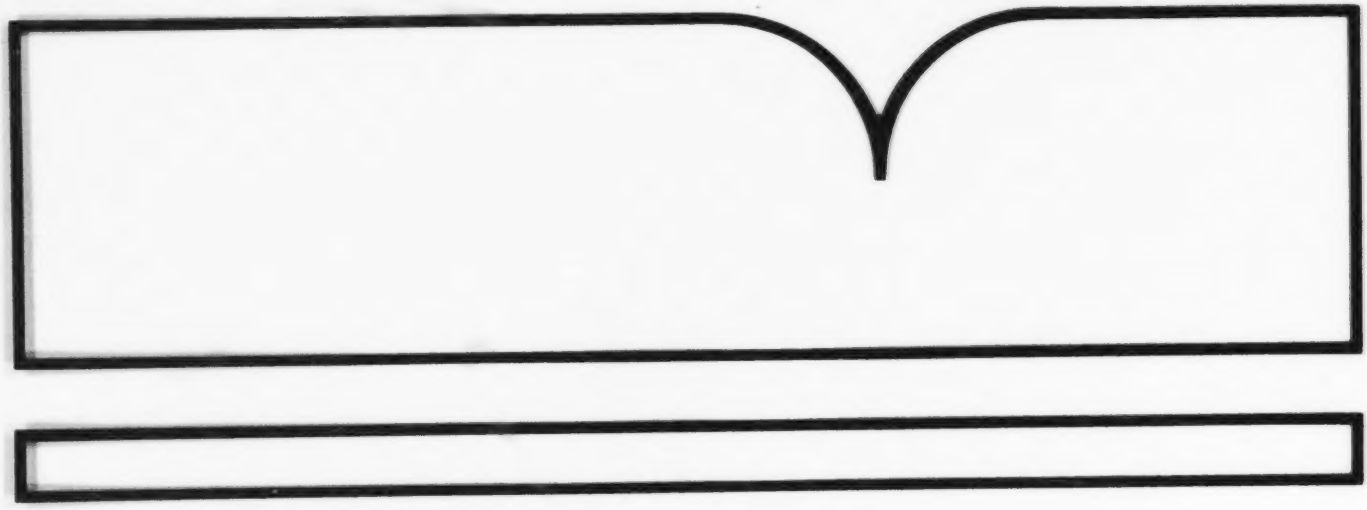
Urban Air Toxics Monitoring Program

(U.S.) Engineering Science, Cary, NC

Prepared for

Environmental Protection Agency
Research Triangle Park, NC

Sep 87



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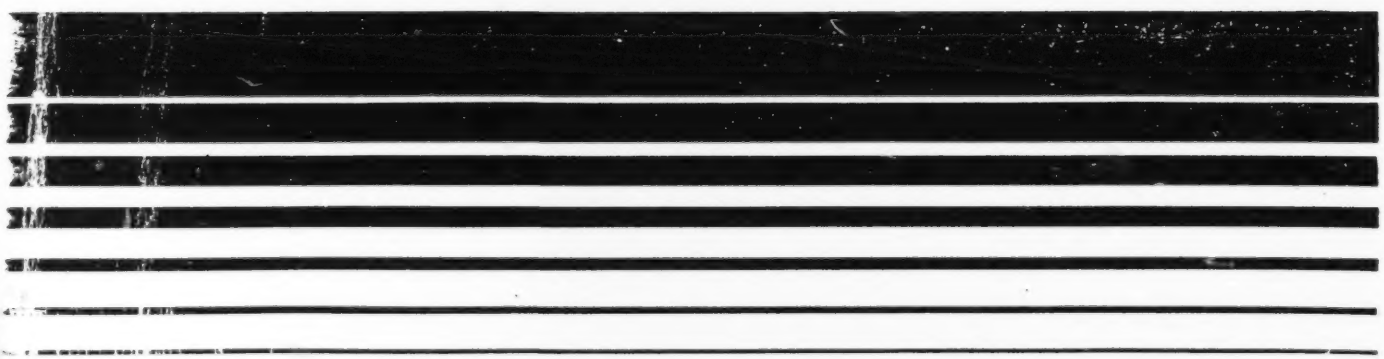

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16. ABSTRACT

To assist States and local agencies, EPA has developed a program to address the status of the air toxics problem in their localities. This document provides a description of (1) the program, (2) support EPA will provide to participating agencies and (3) the responsibilities of State and local agencies.

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URBAN AIR TOXICS MONITORING PROGRAM

By

Engineering Science
Cary, NC

EPA Contract No. 68-02-3888
Project Officer: Dallas Safriet

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office Of Air And Radiation
Office Of Air Quality Planning And Standards
Research Triangle Park, North Carolina 27711

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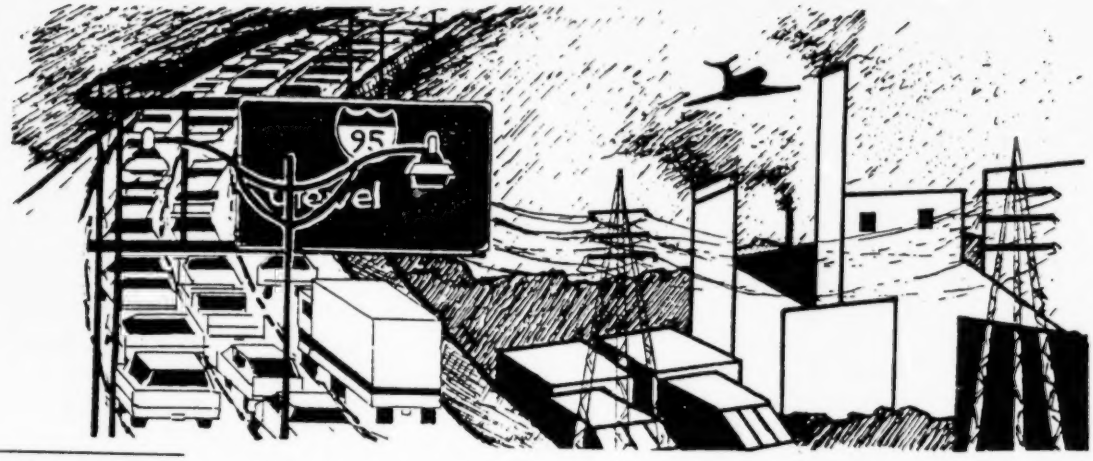
URBAN AIR TOXICS MONITORING PROGRAM



BACKGROUND

The Urban Air Toxics Monitoring Program was developed by EPA as a way for state/local agencies to address the status of the air toxics problem in their localities, and EPA strongly encourages agencies to participate in the program. Following is a brief description of the fundamentals of the air toxics program.

- What is the program? A national ambient screening study sponsored by EPA to assist State and local agencies to assess the nature and magnitude of their air toxics problems, primarily in urban areas.

- Why participate in the program? The monitoring program is in response to the finding of potential increased health risks associated with certain air toxic pollutants. Data generated from the study can be used to determine the presence of levels of high risk substances and the need for additional assessment.

- Where will the program take place? The program is primarily intended to support data collection in major urban areas throughout the United States. However, any area may participate if it wants to address a particular area of concern.

- Who will take part in the program? The program is primarily designed for participation by State and local air pollution control agencies which are being encouraged by EPA to assess the nature and magnitude of the air toxics problem.

- When will the program begin/end? The program begins in early September, 1987 and will continue a minimum of one year after the starting date. Depending on future funding allocation and interest shown by State and local agencies, follow-on programs may be initiated for the next 2-3 years.

URBAN AIR TOXICS PROGRAM DESCRIPTION

Recent studies have indicated a potential of elevated individual lifetime cancer risks associated with certain air toxics often found in urban areas. High risk urban areas result from complex pollutant mixtures rather than from specific point sources which for the most part have been identified and controlled. In response to results of these studies, the Office of Air Quality Planning and Standards (OAQPS) is initiating a screening study entitled Urban Air Toxics Monitoring Program. The primary purpose of the Urban Air Toxics Monitoring Program is to support state and local agency efforts to assess the nature and magnitude of the urban air toxics problem in their respective areas.

EPA's objectives in promoting and supporting this program are:

- o To provide estimates of annual concentrations of selected air toxics,
- o To provide information for prioritizing and planning future work and sampling on a more indepth and pollutant specific basis in local areas,
- o To provide a means to identify prevailing pollutants and possible source types which may need further assessment, and
- o To identify a means to evaluate and prioritize future air toxics mitigation programs.

The program calls for state and local agency personnel to collect ambient air samples for subsequent analysis either by EPA or an EPA contractor for specific toxic compounds (see Table 1).

Three different types of ambient samples are to be collected. The first set of air toxic samples will be collected in stainless steel canisters for 24-hour periods every 12 days for one year. After sample collection, the canisters are air shipped to a central laboratory for analysis. The samples are analyzed for selected volatile organic compounds (VOCs) by gas chromatography. The second set of samples will be collected in cartridges for determination of aldehydes. The third set will be total suspended particulate (TSP) from a high volume air sampler for determination of selected metals and benzo(a)pyrene [B(a)P].

In FY87, States participated in this program at a very reasonable cost of 20 K per site.* State and local agencies (19) which have already agreed to participate in this program are listed in Table 2.

* Cost in FY88 and beyond may vary.

TABLE 1

URBAN AIR TOXICS MONITORING PROGRAM
COMPOUNDS TARGETED FOR ANALYSIS

Canister Sampling	CAS No.	Add-on Cartridge	CAS No.	High-Volume Filter	CAS No.
Vinyl chloride	75-01-4	Formaldehyde	50-00-0	Arsenic[b]	7440-38-2
1,3-Butadiene	51-03-6	Acetaldehyde	75-07-0	Barium[e]	7440-39-3
Benzene	71-43-2	Acrolein	107-02-8	Beryllium[d]	7440-41-7
Methylene chloride	75-09-2	Other Aldehydes		Cadmium[d]	7440-43-9
Carbon tetrachloride	56-23-5			Cobalt[b]	7440-48-4
Ethlyene dichloride	107-06-2			Copper[e]	7440-50-8
Methyl chloride	74-87-3			Chromium[b]	7440-47-3
Trichloroethylene	79-01-6			Iron[e]	7439-89-6
Chloroform	67-66-3			Manganese[e]	7439-96-5
Perchloroethylene	127-18-4			Molybdenum[e]	7439-98-7
Chloroprene	126-99-8			Nickel[e]	7440-02-0
1,4-Dichlorobenzene	106-46-7			Lead[e]	7439-92-1
Acetylene*	74-86-2			Vanadium[e]	7440-62-2
Toluene	108-88-3			Zinc[e]	7440-66-6
Xylene	1330-20-7			B(a)P[c]	50-32-8
o-Xylene					
m-Xylene					
p-Xylene					
n-Octane	111-65-9				
1,3-Dichlorobenzene	54-17-3				
1,2-Dichlorobenzene	95-50-1				
1,1,1-Trichloroethane	71-55-6				
Propylene[a]	115-07-1				
1,1,2-Trichloroethane	79-00-5				
1,1,2,2-Tetrachloroethane	79-34-5				
Styrene	100-42-5				
Bromomethane	74-83-9				
Chlorobenzene	108-90-7				
1,1-Dichloroethane	75-34-3				
1,2-Dichloropropane	78-87-5				
Dibromochloromethane	124-48-1				
Bromodichloromethane	75-27-4				
Chloroethane	75-00-3				
trans-1,2-Dichloroethylene	540-59-0				
Bromochloromethane	74-97-5				
trans-1,3-Dichloropropene	542-75-6				
cis-1,3-Dichloropropene	SEQ-55				
Bromoform	75-25-2				

[a] Acetylene and propylene may coelute on the proposed analytical column, therefore qualitative and quantitative identification may be limited.
[b] Determined by neutron activation analysis (NAA).
[c] Determined by thin layer chromatography (TLC).
[d] Determined by inductively coupled plasma (ICAP) optical emission spectroscopy.
[e] Determined by atomic absorption (AA) spectroscopy.

TABLE 2

PRESENTLY COMMITTED SAMPLING SITES
FOR THE 1987 URBAN AIR
TOXIC MONITORING PROGRAM

U.S. EPA REGION	SITE	URBAN AIR TOXIC MONITORING PROGRAM EMPLOYING 24-HR EVACUATED CANISTER TECHNIQUE
I	Burlington, VT	1
IV	Atlanta, GA	1
	Birmingham, AL	1
	Louisville, KY	1
	Jacksonville, FL	1
	Miami, FL	1
V	Chicago, IL	1
	Cleveland, OH	1
	Detroit, MI	1
	Dearborn, MI	1
	E. St. Louis (Sauget, IL)	1
	Hammond, IN	1
	Port Huron, MI	1
	Midland, MI	1
	East Lansing, MI	1
VI	Dallas, TX	1
	Houston, TX	1
	Baton Rouge, LA	1
X	Portland, OR	1

SUPPORT TO PARTICIPATING AGENCIES

EPA and its central contractor will provide support to participating state and local agencies through the following activities:

- o provide all sampling equipment, including incidental supplies such as canisters, aldehydes cartridges and high-volume filters. The State or local agency is responsible for furnishing and set up of a high-volume sampler for each site selected,
- o set up all necessary equipment, except high-volume, for sample collection,
- o train personnel on program operation and management (equipment operation, sample collection, and sample shipment),
- o provide sample analysis for the preselected pollutants,
- o provide data results, and
- o provide standard operating procedures (SOP) including Quality Assurance (QA) procedures for data collected and analysis.

Under EPA direction, the central contractor will bring the necessary sampling train to each site, assemble the apparatus, instruct the sampling technician on equipment operation and maintenance, and provide detailed sample shipping information. Participating personnel will schedule a meeting date, hour, and location for the contractor to set up and demonstrate the sampling trains.

Use of a central contractor for technical support for all participating agencies is expected to provide: (1) good communications among participating states, EPA, and the contractor; (2) consistency of sampling practices; (3) consistency of overall program operations; and (4) increased accuracy through standardization of analytical procedures in central laboratory.

State and Local Responsibilities

All air toxic samples will be collected by participating agency personnel. Participating agencies will be responsible for:

(1) Selecting personnel and delegating responsibilities to collect samples,
(2) Selecting sampling sites,
(3) Maintaining sampling stations,
(4) Collecting samples,
(5) Shipping samples to laboratory for analysis,
(6) Providing hi-vol sampler, and
(7) Receiving and reviewing data results.

(1) Selecting Personnel and Delegating Responsibilities - Within the framework of the existing agency operation, personnel should be selected and delegated responsibility for site selection, equipment and site maintenance, sample handling, and data interpretation. Selected personnel will be responsible for interaction with central contractor personnel, to ensure program objectives are met.

(2) Selecting Sampling Sites - To better characterize the air toxics situation in their localities, participants are encouraged to select more than one sampling site for each urban area. Two or more study sites would provide a more definitive evaluation of the presence and magnitude of air toxics in the areas of interest.

Monitoring site selection criteria depends upon the objectives of the ambient monitoring program. If the agency is using the data as a secondary tool to roughly assess what pollutants are present in the urban area, it is recommended that the monitoring site should:

- o represent as nearly as possible the typical ambient air quality to which the population is exposed, and
- o not be unduly dominated by a single source (mobile or stationary).

If an existing monitoring site meets these criteria, colocation is recommended.

For a more detailed discussion of criteria for monitoring site selection, refer to Network Design and Site Exposure Criteria For Selected Noncriteria Air Pollutants, EPA-450/4-84-022, September, 1984.

(3) Maintaining Sampling Stations - The central contractor will bring air toxics sampling trains to each of the sites and instruct the sampling operator on how to run them.

The toxics sampling train includes a heated manifold, valves, pumps, flow controllers, timers, and associated hardware, packaged in a medium size case. The central contractor will provide instruction on initial site preparation, sampler installation, operation/maintenance of sampling system and shipment of air toxic sample containers. A more detailed explanation of the sampling train and analytical methods is contained in the Appendix accompanying this document.

The toxics sampling train should be housed in a room that is air conditioned during the summer and heated during the winter to maintain a constant room temperature of approximately 25°C. The high volume TSP sampler should be located close by (perhaps on the roof of the same building).

(4) Collecting Samples - During sampling, agency personnel will collect 24-hour integrated ambient toxic samples in 6-liter SUMMA®-polished stainless steel canisters at participating sites. Evacuated canisters will be filled nearly to atmospheric pressure using a mass flow controller to maintain a constant flow rate for 24 hours.

Formaldehyde samples will be collected on dinitrophenylhydrazine (DNPH)-coated Sep-PAK® cartridges at 1 L/min for 24 hours, using a critical orifice and a vacuum pump. The canisters and the formaldehyde cartridges will be filled from a common heated stainless steel line. Duplicate samples will also be collected periodically.

TSP samples will be collected in the hi-vol sampler simultaneously with the canister and cartridge samples at each monitoring site.

(5) Shipping Samples - Filled sample canisters, hi-vol filters, and Sep-PAK® cartridges will be identified and shipped to the specified laboratory for analysis. Fresh empty canisters, filters, and cartridges will be delivered to the participating agency prior to each day that samples are scheduled to be taken. The central contractor will furnish shipping instructions to site operators when the site is activated. All samples should be shipped as soon as possible after collection.

Upon receipt of the air toxic samples, the central laboratory will analyze for formaldehyde, other aldehydes, ketones and selected organics (Table 1) within a few days. Results of these analyses are reported quarterly and provided to the participating agency. Results for the hi-vol samples [B(a)P and metals] will require more time due to the QA/QC validation program as part of the National Particulate Network (NPN) program. Results for B(a)P and metals will be made available to the participating agencies approximately six months after sample submittal.

OPTIONAL AMBIENT NMOC/SPECIATED VOC PROGRAM

Many states are currently participating in the Non-methane Organic Compound (NMOC) program. The current NMOC program is a continuation of the NMOC Monitoring Network Program which focused on collection of total NMOC data for ozone State Implementation Plan (SIP) development. EPA has managed the current NMOC program for the past four summers (1984-87). The purpose of the NMOC program is to collect total and speciated NMOC and nitrogen oxides (NO_x) data needed for ozone SIP modeling analyses.

Participating State and local agency personnel collect samples in canisters and air freight them to Research Triangle Park for analysis by a central contractor. Agencies are provided with all necessary sampling equipment which they colocate with a NO_x monitor. NMOC canister samples are collected from 6-9:00 a.m. every week day for four months (June-September). FY87 costs for participating agencies are 19K per site.* Participants of the ambient NMOC and speciated programs are listed in Table 3.

The NMOC program is conducted in the same manner as the air toxics program. NMOC participants have the same responsibilities as those taking part in the air toxics program. Criteria for delegating program responsibilities, selecting sampling sites, sampling train operation/maintenance, sample shipment and data review are common to participants of both programs.

Total NMOC concentrations are determined by the Preconcentration and Direct Flame Ionization Detection (PDFID) method. Some of the samples are further speciated by the GC/FID method. In a supplementary limited effort to characterize air toxics, some samples are also analyzed for toxic species by a GC-multi-detector procedure. This additional analytical program will cost an additional $2K.

* Cost in FY88 and beyond may vary.

TABLE 3

CURRENT PARTICIPANTS IN THE AMBIENT 3-HR NMOC AND SPECIATED PROGRAMS USING PRESSURIZED CANISTER TECHNIQUE

U.S. EPA REGION	SITE	3-Hr NMOC PROGRAM SITES USING PRESSURIZED CANISTER TECHNIQUE	
		TOTAL NMOC	SPECIATED
I	Boston, MA	2	2
	Hartford, CT	1	
II	New York, NY	2	2
	Newark, NJ	1	1
IV	Atlanta, GA	2	2
	Birmingham, AL	1	1
	Louisville, KY	1	1
V	Chicago, IL	2	2
	Cincinnati, OH	1	1
VI	Dallas, TX	1	
	Ft. Worth, TX	1	
	Houston, TX	1	
	El Paso, TX	1	
	Beaumont, TX	1	
	Longview, TX	1	
	Baton Rouge, LA	1	
VII	St. Louis, MO	1	
VIII	Salt Lake City, UT	2	
IX	San Francisco, CA	2	
	San Diego, CA	2	
	Fresno, CA	2	
	Bakersville, CA	1	
	Pittsburgh, CA	1	
X	Portland, OR	1	

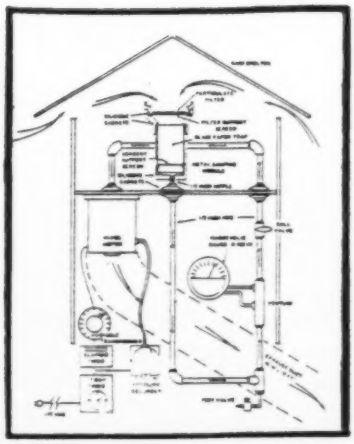
Limitations of the supplementary air toxics portion of this program are:

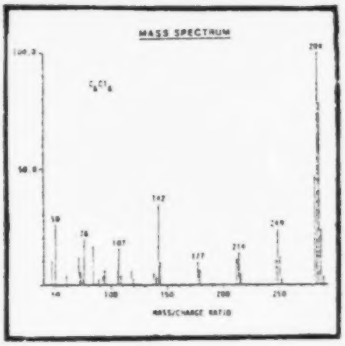
- o sampling is done only during the summer, and
- o relatively few ambient air samples are analyzed for specific air toxics.

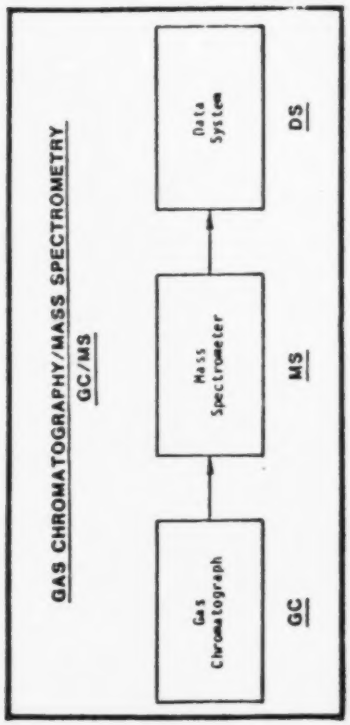
Recognizing these limitations, USEPA encourages participation in the more comprehensive Urban Air Toxics Monitoring Program, the results of which should provide a more adequate data base on which to structure an agency air toxics program.

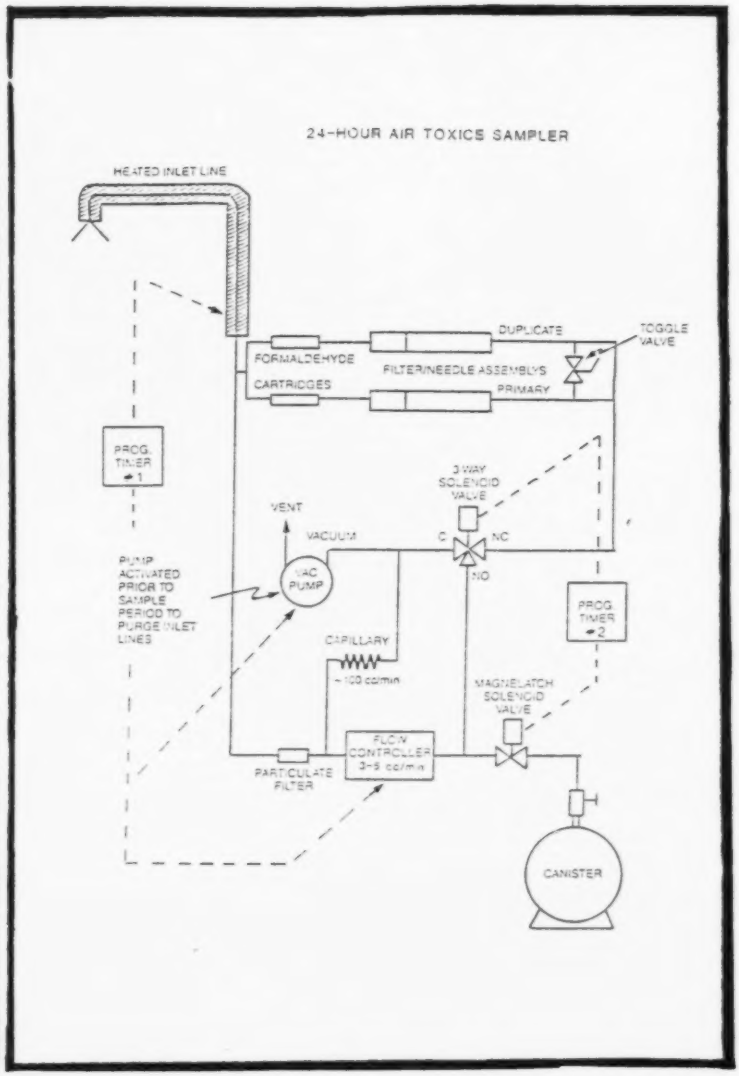
APPENDIX

Sampling Techniques
Equipment
Sample Analysis









SAMPLING TECHNIQUES/EQUIPMENT

Urban air toxics samples are collected in 6-liter SUMMA® polished canisters. Formaldehyde samples are collected in DNPH-coated cartridges. Canister sampling for VOCs is an alternative to VOC collection on solid sorbent (Tenax). Many VOCs which cannot be collected on Tenax (due to high volatility, polarity, or reactivity) can be efficiently collected and stored in canisters. Also, the canister contents may be analyzed repeatedly. The central contractor will prepare and deliver all sampling medium to agency personnel.

Coated adsorbent cartridges are used as direct probes and traps for sampling aldehydes in ambient air. Aldehyde sample collection is based on the reaction of aldehydes with the acidified, DNPH-coated cartridges to form a stable derivative which is then analyzed to determine the concentration of the aldehydes.

SAMPLING TECHNIQUES

Evacuated Canister Sampling

In the canister sampling method, ambient air is collected in an evacuated canister while maintaining a constant flow rate with an electronic flow controller. Figure A-1 shows a schematic of the sampling system equipped with evacuated canisters and DNPH-coated cartridges. The canisters are then returned to the laboratory for analysis of the collected ambient air samples. Collection of ambient air samples in canisters provides a number of advantages, including:

- o convenient integration of ambient samples over a specific period,
- o ability to ship and store samples,
- o remote sampling capability, with subsequent central laboratory analysis,
- o unattended sample collection,
- o analysis of samples from multiple sites with one analytical system, and
- o collection of replicate samples for assessment of measurement precision.

DNPH-Coated Cartridge Sampling

In the cartridge sampling method, ambient air is passed through the same heated stainless steel manifold that is used for filling the canisters. Ambient air is drawn through the cartridges for 24-hours at a constant flow rate. Periodically, duplicate samples are collected. Figure A-1 illustrates the sampling system.

After sampling, the DNPH-coated Sep-PAK® cartridges are capped at each end and placed in a glass culture tube to minimize contamination. The culture tube is then shipped back to the lab for analysis.

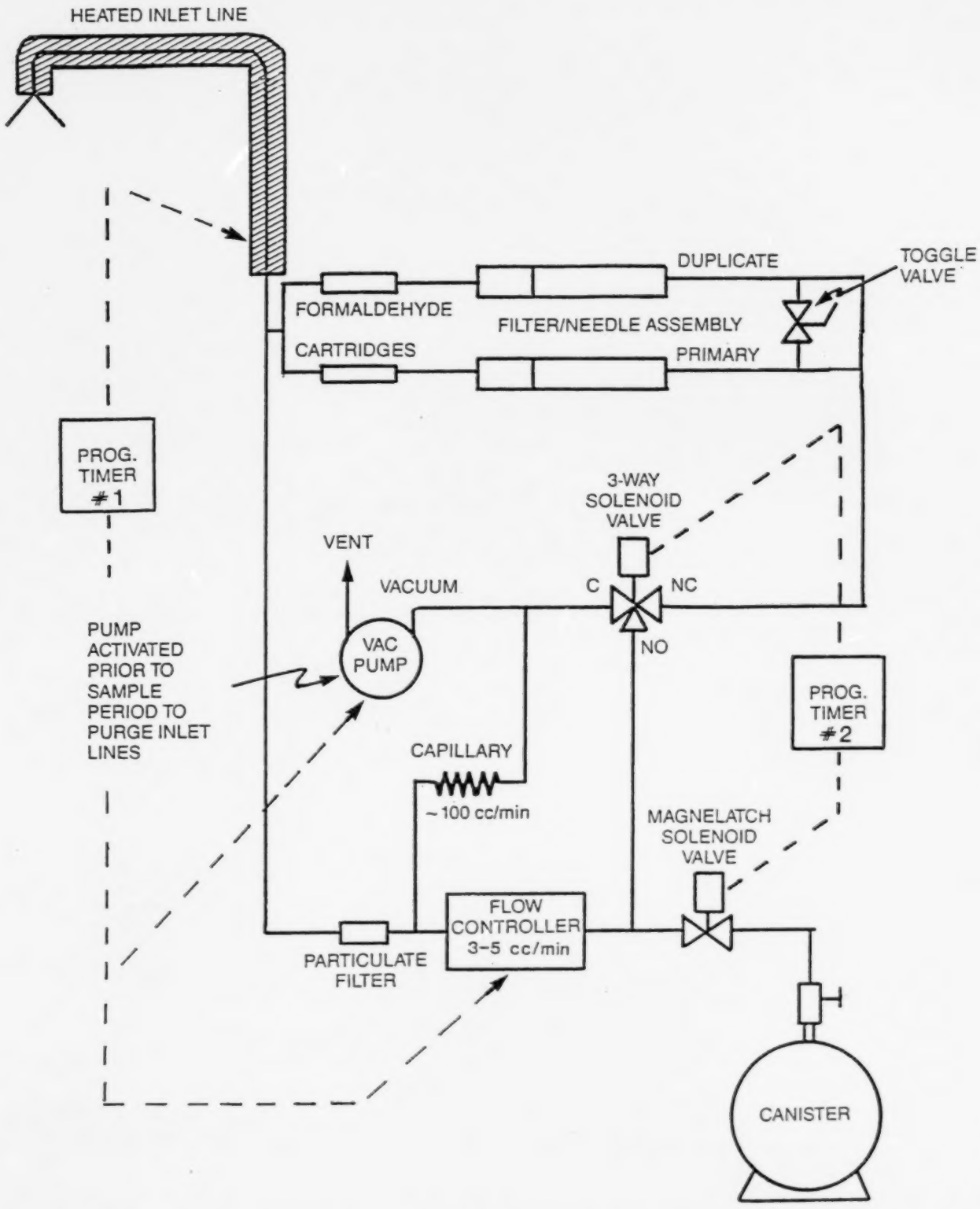


FIGURE A-1. SAMPLING ASSEMBLY FOR 24-HOUR URBAN AIR TOXIC MONITORING PROGRAM

Filter Sampling

In the filter sampling method, ambient air is sampled by a high volume air sampler. Total suspended particulate (TSP) is collected on the filter at a continuous air flow rate of 40-60 ft^3/min. After sample collection, the glass fiber filter is placed in a clean, sealed container, shipped to the central laboratory, and analyzed for metals and B(a)P.

SAMPLING EQUIPMENT

Ambient air is drawn into a sampling train comprising an evacuated canister(s) and DNPH-coated cartridge(s), and other components e.g., an electronic flow controller that regulate the rate and duration of sampling. The canister is treated internally by the "SUMMA" polishing process in which a pure chrome/nickel oxide is formed on the interior surface. This type of canister has been used in the past for sample collection and a number of studies have been performed to demonstrate analyte stability in the canisters.

The inlet system consists of a stainless steel filter to remove aerosols, and a stainless steel inlet line leading to a flow controller, pump, canister(s) and cartridge(s). During operation, the flow controller maintains a constant flow rate to the pump. Air flows into the initially evacuated canisters and through the DNPH coated cartridges until sampling is complete.

For automatic operation, the timer starts and stops the pump at the appropriate time for the intended sample period. The timer also controls the solenoid valve.

Prior to field use, each sampling system will be tested for pump contamination, leaks, and proper flow rate. The canisters will also be cleaned and checked for contamination before use.

SAMPLE ANALYSIS

The central contractor will arrange for analysis of the samples collected and shipped to the specified laboratory by agency personnel. The analytical laboratory will follow analytical procedures prescribed by EPA for determination of preselected air toxic compounds. Organic toxic compounds will be analyzed using gas chromatography techniques, aldehydes will be analyzed using high performance liquid chromatography (HPLC), metals will be analyzed using atomic absorption/emission methods, and B(a)P will be analyzed by thin-layer chromatography. Table 4 outlines the sampling schedule and sampling analysis for each of the programs discussed. Following is a brief description of the analytical techniques for each program.

TABLE 4

SAMPLING SCHEDULE/ANALYSIS FOR MONITORING PROGRAM

Program	Pollutant	Sampling Schedule			Sampling Configuration	Sampling Analysis			Comments
		Period	Date	Length		Trapping	GC Column	Detector[1]	
Ambient NMOC Monitoring Program	Total NMOC	3-hr 6:00-9:00 A.M.	Each week day	June - Sept.	Pressurized SUMMA® Polished Canisters	Cryogenic (liquid argon)	None	FID	NMOC Monitoring Network Program. Sample Analyzed by PDFID
	10% of Total NMOC Canisters Speciated Analysis	3-hr 6:00-9:00 A.M.	Each week day	June - Sept.	Pressurized SUMMA® Polished Canisters	Cryogenic (liquid argon)	Fused Silica	FID	Speciated Analysis by GC/FID. Used as QA/QC for NMOC Monitoring Network Program
	Speciated Analysis	3-hr 6:00-9:00 A.M.	Each week day	June - Sept.	Pressurized SUMMA® Polished Canisters	Cryogenic (liquid argon)	Fused Silica	PID/ECD/FID	
Urban Air Toxic Monitoring Program	Speciated Analysis	24-hrs	Every 12th day	Year	Evacuated SUMMA® Polished Canisters	Cryogenic (liquid argon)	Fused Silica	PID/ECD/FID	

1
FID- Flame Ionization Detector
PID- Photoionization Detector
ECD- Electron Capture Detector
PDFID- Preconcentration and Direct Flame Ionization Detection Method

3-Hour Total NMOC Analysis

Total NMOC are extracted from the 3-hour canister samples through a glassbeaded trap cryogenically cooled to approximately -186°C with liquid argon. The cryogenically-cooled trap simultaneously concentrates the NMOC (either via condensation or adsorption) while separating and passing methane, nitrogen, oxygen, etc. through the trap. The system is dynamically calibrated so that the volume of sample passing through the trap does not have to be measured, but must be precisely repeatable between the calibration and the analytical phases.

After the fixed-volume air sample has been drawn through the trap, a helium carrier gas flow is diverted to pass through the trap and into a flame ionization detector (FID). When the residual air and methane have been cleared from the trap and the FID baseline becomes steady, the cryogen is removed and the temperature of the trap is raised to approximately 90°C.

The organic compounds previously collected in the trap volatilize and are carried into the FID, resulting in a response peak(s). The area of the peak(s) is integrated and the value is translated to concentration units by a previously obtained calibration curve relating integrated peak areas with known concentrations of a standard.

Concentrations of NMOC are reported in units of parts per billion carbon (ppbC), which, for a specific compound, is the concentration by volume (ppbv) multiplied by the number of carbon atoms in the compound.

3-Hour Speciated NMOC Analysis

Analysis of the 3-hour speciated NMOC is by gas chromatograph equipped with photoionization, electron capture and flame ionization detectors.

For separation and subsequent identification by selective detectors, GC technique relies primarily on the analytes' retention times on the fused silica column.

The analytical system concentrates (by the cryogenic trap) approximately 250 mL of sample from each canister for analysis by gas chromatography, using electron capture (EC), photoionization (PID), and flame ionization detectors (FID). The interface between the canister and the GC column is designed to concentrate the air sample by cryogenic trapping at subatmospheric pressure. The trap is then heated and the previously collected organic compounds volatilize and are carried to the GC column by the carrier gas. The GC column is temperature programmed from subambient cooling to provide improved resolution for the compounds of interest. The column separates the organics and the effluent gas stream containing the separated organics immediately enters a series of detectors appropriate for the compound being determined. The individual components appear as a succession of peaks above a baseline on the chromatogram.

The area under the peak approximately quantifies the component, while the time lapse between injection and emergence of the peak serves to identify it.

In addition to GC/FID for all 3-hr NMOC samples, a minimum of 10% of the canister samples will be speciated in a GC/FID equipped with a fused silica column. This will serve as a QA/QC check of the ambient NMOC monitoring program while providing additional analytical data.

24-Hour Speciated Air Toxic Analysis

The 24-hour Urban Air Toxic evacuated canisters are analyzed according to the previously described speciated 3-hour NMOC analysis. In summary, the organics (See Table 1) in the canister are concentrated in a cryogenic trap, re-volatilized, separated on a fused silica capillary column and monitored by PID, ECD, and FID electronic detectors. The combination of the three detectors enables the detection of different classes of organics which normally could not be evaluated by a single detector. The VOCs in the canister are qualitatively and quantitatively characterized through the GC/multi-detector procedure.

ALDEHYDE ANALYSIS

Aldehydes are extracted from the DNPH-coated Sep-PAK® cartridges by gravity feed elution of acetonitrile from a plastic syringe reservoir to a graduated test tube or a volumetric flask. The eluate is then topped to a known volume. The DNPH-formaldehyde derivative is determined by reverse phase high performance liquid chromatography (HPLC) with an ultraviolet (UV) absorption detector. Formaldehyde and other carbonyl compounds in the sample are identified and quantified by comparison of their retention times and area counts with those of standard samples.

METAL ANALYSIS

Metals in the TSP samples are analyzed by atomic spectroscopy. Atomic spectroscopy is performed by atomic absorption or atomic emission. This technique measures energy changes in the atomic state of the metal ion. In atomic absorption, the atoms in the ground state absorb energy, become excited, and advance to a higher energy level. Radiant energy of the characteristic wavelength to produce this transition is shone through the cloud of atoms and the amount of energy absorbed by the atoms is observed. The concentration of metal atoms in the sample is directly proportional to the energy adsorbed.

Atomic absorption is currently the most widely used technique of atomic spectroscopy. It suffers from the disadvantage that it is essentially a single element determination. However, atomic absorption can be carried out swiftly with available standardized procedures and equipment. Atomic emission using a flame is used for a few elements such as the alkali metals and alkaline earths. It is not very sensitive for other elements because of the relatively low temperatures of available flames. However, the recent adaptation of plasma technology, particularly the inductively coupled argon plasma (ICAP) where temperatures approaching 1000 K are obtained, has made atomic emission a practical technique for determination of most metals. It is a technique for simultaneous multielement determination and offers an economical means to generate a great deal of data.

B(a)P ANALYSIS

B(a)P and other polycyclic organic matter (POM) are captured on the hi-volume filter by drawing air through the filter at a rate of 40-60 ft^3/min. At the end of the sampling period, the filter is retrieved and returned to the central laboratory for analysis.

For analysis, a portion of the filter (1-in. by 8-in. strip) is immersed in cyclohexane and sonicated to extract the residual B(a)P. A sample of this solution is spotted on a thin-layer plate and developed in an ethanol/methylene chloride matrix to separate the dissolved B(a)P from other POM's. The B(a)P is then quantified by ultraviolet fluorescence spectrometry. The analytical range of the method is 0.4 to 8.0 ng/80 uL, which corresponds to 0.18 to 3.6 ng/m^3, assuming an air volume of 2000 m^3.

DETECTION LIMIT

The analyses of the collected samples will identify those chemical species (Table 1, in the main document) which are present in concentrations which equal or exceed the sensitivity of the proposed test methods. For those compounds identified, an approximation of their concentrations will be obtained. Historically, detection limits for GC/FID, GC/ECD, and GC/PID are 200 pg, 0.1 pg, and 1 pg, respectively. In general, the normal sampling/analysis detection limits associated with each method are estimated as:

Technique	Pollutant	Estimated Detection Limit
Evacuated Canister	Organics	1.0 ng/m^3
DNPH-Sep-PAK® Tubes	Aldehydes	18.0 ng/m^3
High Volume	Metals	4.0 ng/m^3
High Volume	B(a)P	0.18 ng/m^3